



Explosives Safety

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Stopping Explosives Accidents

The Army's peacetime explosives accident experience suggests that soldiers are disregarding safe practices. Users of explosives are not following established procedures; they are even bypassing control mechanisms designed to ensure safety. This casual approach to dangerous systems can only result in disaster. Any unit using pyrotechnic simulators or employing demolitions is subject to explosives accidents.

The information in this packet, based on Armywide accident experience during FYs 86 and 87, focuses on Army explosives accidents by military users. It does not include explosives accidents that occurred in the development or storage of explosives devices or munitions or accidents involving individual or crew-served weapons or weapons systems.

Injured soldiers were hospitalized for 1,428 days, lost an additional 2,280 workdays, and could only perform in a restricted capacity for an additional 4,097 days. This lost manpower is all the more critical with the continuing personnel cutbacks.

Sound, proven safety procedures exist for the storing, handling, and employment of all explosives. Any deviations from these established procedures can be catastrophic. Supervisors at all levels must be aware of all safety procedures involved for each munition or device, and they must ensure strict compliance.

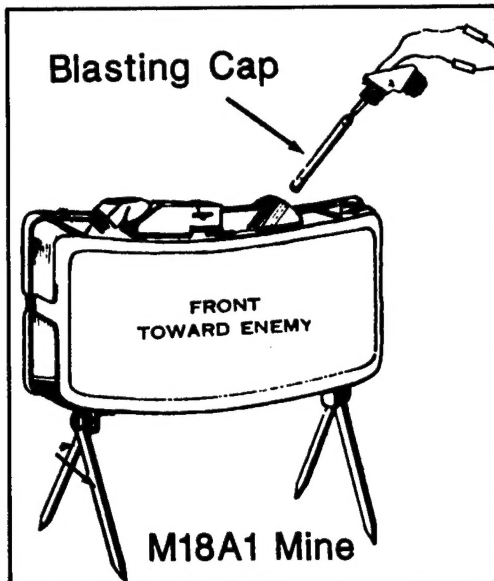
The following accident recaps are intended to help commanders and other unit leaders gain additional insight into preventing these kinds of accidents in the future.

Leader's Guide to Accident Prevention Series



DTIC QUALITY INSPECTED 4

Demolitions



Accidents involving conventional demolitions represent only 4.5 percent of all explosives-related accidents, but they account for 89 percent of the fatalities.

- **Claymore mine.** The safety leader failed to make a final safety check of the practice Claymore mine to be used for a demonstration. A live blasting cap had been inadvertently placed in the mine, but it was not detected. In a demonstration of how the igniter worked, the live blasting cap exploded, injuring the soldier and four spectators.

Improper attention to safety procedures will cause injury. Stress that live and dummy explosives should never be mixed. Inspection of equipment should always be thorough and timely.

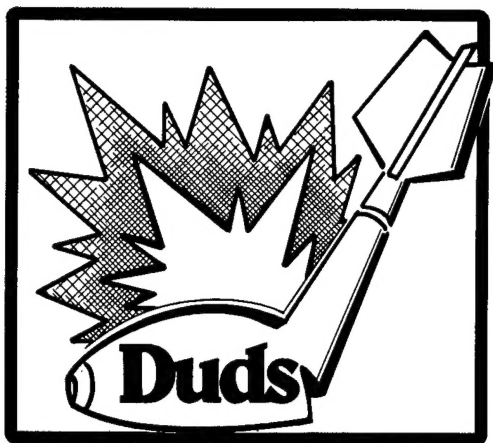
- **Bangalore torpedo.** A platoon participating in a combined arms live-fire exercise reached a three-row concertina wire obstacle. Four soldiers placed munitions, including three Bangalore sections, leaving one soldier in position to activate the system while the other three returned to the M113. The lone soldier pulled the fuse igniter with no results. He then pulled it twice more, still without results. He signaled a "no-go," and another igniter was brought in. The three soldiers changed the igniter but made no effort to ignite the fuse. One of the soldiers attempted to reattach the M-7 non-electric blasting cap to the time fuse by tapping it with a knife instead of using the M-2 crimper. They were kneeling around the downhill end of the Bangalore torpedo working on the ignition system when it exploded. All three soldiers were killed instantly.

The necessity to follow established procedures cannot be overstated. Only the minimum of personnel necessary to get the job done should handle a misfire. Personnel should always use the proper tools and equipment.

- **Tree stump charge.** A charge of 10 blocks of C-4 was set to remove a tree stump. The C-4 in use, however, was a civilian-type explosive twice as powerful as that the soldiers had been trained to use. Before igniting the charge, the OIC instructed that personnel be evacuated to a previously designated safe site. The distance of the safe site was calculated for the less powerful military charge by an inexperienced lieutenant whose overconfidence led him to miscalculate the distance needed to keep his soldiers safe. The Range Safety Officer did not check the calculations. When the charge was detonated, a shower of flying rocks spewed into the group of soldiers at the safe site. One soldier was struck in the head and killed.

Carelessness, brought on by overconfidence, caused this accident. There is no room for miscalculation when handling explosives. Commanders must stress proper training on all types of explosives before allowing personnel to perform with them. Additionally, personnel should be informed of problems and possible countermeasures associated with each type explosive.

- **Duds.** While detailed to guard military equipment on a field exercise, two soldiers walked down range into an off-limits area. Seeing hundreds of MK-20 bomblets from a cluster bomb unit laying unexploded on the ground, the soldiers began throwing them at targets. Since some of the bomblets didn't explode, one of the



Don't touch them!

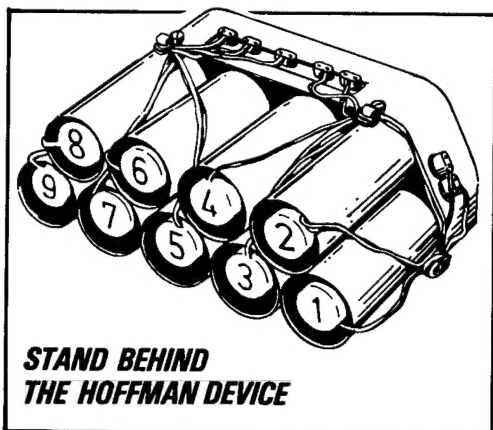
Contact: Local Police or Military Police

soldiers decided they were duds and took one back to his barracks. As he was hiding the MK-20 in his ceiling, he dropped it. It exploded, blowing out the room's windows and peppering the walls and door with shrapnel and injuring the soldier. The downward force of the shape charge is all that kept this soldier alive.

- The range police detail was clearing refuse and duds from a range. Standing about 15 meters from his truck, one of the soldiers tossed a 20mm round into the truckbed. The round exploded, and a piece of shrapnel struck him above the left ear.

These soldiers failed to practice proper safety precautions. Proper safety must be stressed at all levels of command. Too many soldiers don't realize that duds are really dangerous. They're not toys; they're not firecrackers. They're very real and they can cause very real injuries. They certainly aren't meant to be souvenirs. Duds should be treated with the same respect shown live shells. Only trained EOD personnel should handle them.

Pyrotechnic simulators



**STAND BEHIND
THE HOFFMAN DEVICE**

Pyrotechnic simulator devices accounted for 192 of the 240 reported explosives accidents. Although simulators do not normally kill (1 death in 192 accidents), they do injure; that results in an expensive loss of manpower. More than 225 injuries resulted from the 192 accidents, and injury and damage costs totaled more than \$1.4 million. This cost will continue to rise as medical costs are ongoing for soldiers still undergoing treatment.

- **Hoffman device.** The most frequently occurring accident involving any single type explosives device is with the Hoffman. **More than half of all Hoffman accidents involve soldiers attempting to disassemble, cut open, modify, or hand ignite this device.** This simulator must be used only for its intended purpose and only in the way it was designed to be used. It is not suitable for modification for any other use: It doesn't make a good booby trap or any other modified device; it does make a good Hoffman device. The Hoffman, the Atwess, and most other flash-type simulators contain a magnesium photoflash compound that is classified as a mass detonating explosive and detonates like TNT. It also burns much faster than gunpowder and generates extremely high temperatures. Soldiers should never cut open or otherwise tamper with simulator devices. Commanders must educate soldiers in proper handling and use of pyrotechnic devices to prevent the following types of accidents.

- When the Hoffman device failed to detonate, a soldier brought it inside the M113 in which he was riding. He failed to disconnect the charge from the battery. The Hoffman exploded inside the track, burning and cutting the soldier and putting him on limited duty for several days.

- Another soldier was extracting what he thought was gunpowder from a Hoffman charge when his platoon leader discovered him. The platoon leader took the Hoffman charge from the soldier and tried to remove the powder himself. He made a neat pile of powder on top of his track and bent over to light the pile with his cigarette lighter. The powder flared up, and the platoon leader received second- and third-degree burns to his face and left arm.



- While guarding the perimeter of a battalion maintenance collection point, a soldier attempted to rig an early warning trip wire with a Hoffman round. The soldier made a fuse from a spring and a bottle. While setting the trip wire, the soldier accidentally completed the circuit and discharged the round.

- The unit was being evaluated and had been briefed on the mission by the battalion commander, a lieutenant colonel. The S-3, a major, asked if the command had any simulators or pyrotechnics that could add noise or realism to their mission. They had only some smoke and simulator tank burst 50mm cartridges for Hoffman devices, but no actual Hoffmans. After much discussion, another major, the battalion XO, suggested the 50mm could be "hot wired" for firing without the Hoffman device. He had seen this done many times by both active and Reserve troops to detonate simulators.

It was agreed that unit personnel not familiar with this procedure would not be required to use the hot-wired explosives. Those who planned to do so were instructed to hook one simulator to one 20-foot section of wire. They were then briefed on some of the hazards: Static electricity can detonate charges hooked up in this manner; each simulator equals about a quarter of a stick of TNT; simulators should be detonated at least 20 feet from the tank.

One crew decided it would take too long to fire their simulators one at a time, so they modified the simulators into sets of four and placed them in front of the tank's position. No attack came, and three sets of simulators were detonated in place before moving from the position. The crew continued setting and moving the simulators until chow time. The tank commander pulled one of the sets up on the tank near his hatch and noticed that a wire had come loose from the set and one simulator had failed to detonate. He held the set in place on the box until the tank stopped and then he attempted to rewire the simulator. It exploded, injuring him and his crew-members.

It is a misconception that only junior enlisted personnel should not handle pyrotechnics. All personnel using these devices must be trained and briefed before using any pyrotechnic simulators. Never assume that, just because soldiers have been in the Army a long time, they have had experience with and know how to use all pyrotechnic devices.

- **ATWESS.** A soldier's curiosity led him to take apart an ATWESS device just to see what was in it. Wanting to see what would happen to the "little black cylinder," the soldier lit a match and dropped it in the cylinder. It ignited, severely burning his right hand and wrist.

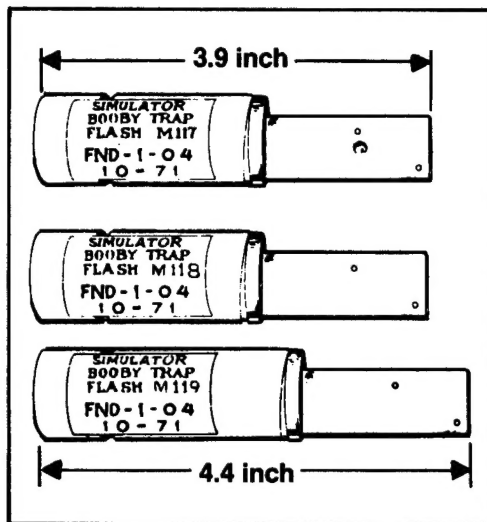
- The loader on a TOW tracking exercise had been briefed before the exercise on loading, firing, unloading, and safety of the M22 ATWESS simulator cartridge. Even though the loader had been briefed not to stand behind the weapon, he had twice loaded the cartridge from behind and twice was reprimanded for doing so. He was twice shown the correct method of loading the M22 ATWESS from the side of the launch tube. On the third attempt, he again loaded from behind the launch tube. Before he could be stopped, he inserted the simulator and closed the breech. For unknown reasons, it fired with the loader still in the back blast area.

There is no substitute for following correct procedures. Soldiers must be reminded constantly of the dangers of pyrotechnic devices, especially the hazards of unauthorized use.

They should be taught not to tamper or experiment with

pyrotechnics. Commanders should stress training so that all soldiers know how to use the Hoffman and the ATWESS properly. Safety briefings should include instructions and demonstrations on use of blanks and simulators, to include instructions on the dangerous features of the Hoffman and the ATWESS.

Booby trap simulators



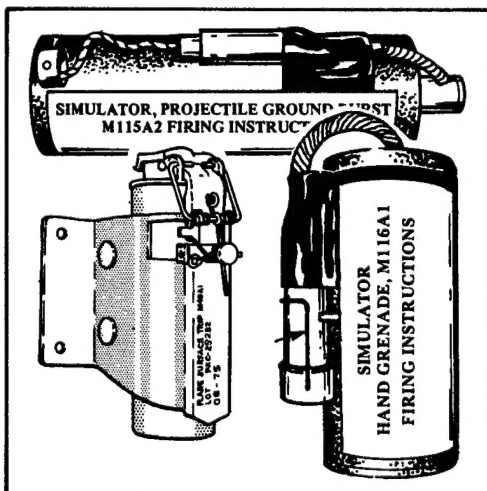
There are three basic booby trap simulators: the M117, M118, and M119. Each has a tubular body and a similar appearance. A soldier who is not **thoroughly** familiar with these devices can easily confuse them. Each type reacts differently when ignited, and a mistaken identity can cause serious injury. Ensure only trained, informed soldiers handle booby trap simulators.

- Supply failed to furnish instructions with the new box of M117 simulators, and the soldier paid no attention to the warning printed on the simulators. As a result, one of the simulators exploded in his hand.

- In the darkness, the squad leader failed to find out what type simulators he had just provided his soldiers. When one of the soldiers pulled the string, the flash simulator exploded in his hand.

- Upon mission completion, the battalion was moving back to base. A soldier was told to expend a box of pyrotechnics that would not be taken back. A captain identified them as whistlers, and the soldier detonated them by hand with no problems. The soldier accepted another box and, while expending the rounds, one of them exploded in his hand immediately after he pulled the string. This soldier received three lacerations and first- and second- degree burns to his right hand because the wrong kind of simulator got mixed in with a batch of whistlers and he failed to recognize the difference.

Artillery simulators, grenade simulators, and trip flares



These devices are also involved in a large number of accidents, most of which are caused by tampering and throwing too close to personnel. Commanders must ensure that excessive motivation and aggressor play are controlled at all times. Positive inventory control can also reduce tampering and unauthorized use.

- **Artillery simulator.** After his truck ran over and broke open a simulator, a soldier threw his cigarette on the black powder spilling out. The flash fire burned his face and put him in the hospital.

- **Grenade simulator.** While on night patrol, soldiers fired blanks at another unit. A soldier from the unit under attack threw a grenade simulator at the opposing patrol. It exploded at the feet of another soldier who suffered a temporary loss of hearing and neck pain from the noise.

- **Trip flare simulator.** In direct violation of the UCMJ, a soldier had a trip flare simulator in his possession at a privately owned arcade. When he attempted to set it off, it exploded in his right hand. He was hospitalized for 8 days and on restricted duty for 30 additional days before facing a UCMJ action.

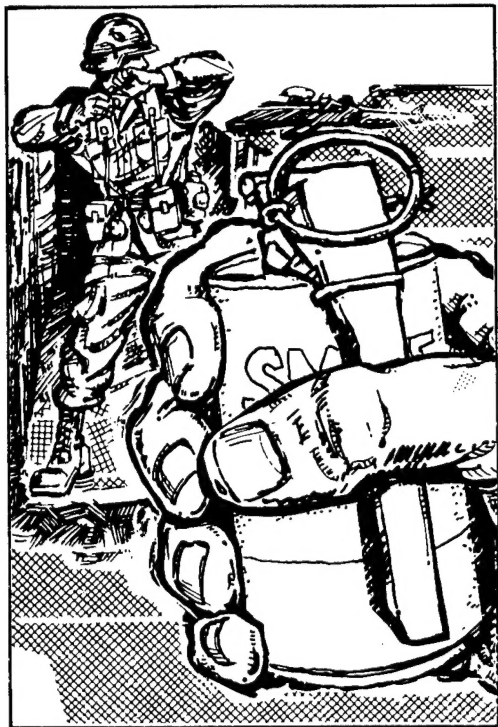


While on a field training exercise simulating artillery on a convoy, a soldier tried to set off several different simulators. None exploded. The soldier cut the casing on one simulator, spilled the powder onto the ground and lit it. The flash caused second-degree burns to his face and hands and put him in the hospital for 3 days.

Four members of an aggressor fire team were in the woods approaching the tree line by twin lakes when one of the team members set off a trip flare at neck level. Gun powder from the blast irritated the cheek area under his right eye and caused irritation in his right ear as well as some hearing loss.

Trainers must be vigilant in teaching proper procedures and forceful in warning of possible dangers. The Army has prepared handy 4"x5" booklets for pyrotechnic simulators (TM 9-1370-207-10), pyrotechnic signals (TM 9-1370-206-10), and photoflash cartridges and surface flares (TM 9-1370-208-10) that fit easily into a field uniform pocket. Make sure each soldier who handles pyrotechnic simulators has read and knows these manuals. All briefings should include field safety procedures.

Smoke



- Twenty-two soldiers on an air assault course were crossing through a low tunnel that had about 6 inches of water in it. When the primary instructor threw a smoke grenade inside the tunnel, the smoke, the confined space, and the water all combined to form a very dense stagnant smoke. All 22 soldiers suffered smoke inhalation and required hospitalization. One soldier subsequently died of complications from the smoke.

Pyrotechnics can kill. Commanders must set the safety rules through appropriate SOPs and stress adherence by teaching soldiers to give pyrotechnics their due respect.

- **Do** read and follow operating instructions.
- **Do** recognize that all pyrotechnic simulators contain hazardous materials.
- **Do** keep all simulators away from fires. Remember, photoflash powder ignites instantly.
- **Do** realize that pyrotechnics can cause irritation if smoke is inhaled or if residue gets on the skin.
- **Do** aim pyrotechnic simulators away from other people. A simulator thrown into a tent or vehicle causes injuries and property damage and can result in court martial.
- **Do** wear standard issue leather gloves on firing hand.
- **Do** give pyrotechnic simulators a lot of respect.

Ammunition and weapons systems

These systems are extremely dangerous and must be handled with safety as the primary concern. Although no fatalities were recorded during the reporting period, these munitions have killed before and their misuse continues to cause serious injuries.

- The platoon was on line throwing grenades on command with a 1-second cookoff. Two soldiers standing about 1 meter apart were injured when a grenade exploded during the cookoff time before it was thrown.

- Two squads, about 150 meters apart, were involved in breaching operations with flares, artillery simulators, smoke pots, smoke grenades, and blanks. The attacking squad members were firing grenade launchers and 40mm practice rounds. Due to the dense smoke, one of the attackers apparently lost his bearings and fired into what he thought was dead space. An M203 round ricocheted off an obstacle and hit a soldier, fracturing his arm.

Miscellaneous



Many other devices cause accidents. An explosive device in the hands of an untrained person creates a dangerous environment. Soldiers must be repeatedly cautioned as to the dangers of explosives and must not be allowed to tamper or experiment with explosive materials.

- An aggressor force looking for realism in their training decided to use civilian firecrackers instead of grenade simulators. One soldier, deciding to break open the firecrackers, spread the powder on the ground. When lit, it exploded in the soldier's face.

- A soldier opened an M80 blast simulator and poured the contents on the ground. When he lit the powder, he suffered a flash burn on his right hand that put him in the hospital for 8 days and on restricted duty for a month.

- The unconventional warfare (UCW) team had just completed a raid on the brigade supply area. As they were making their escape, the opposing team started firing star clusters at them. The first star cluster landed in front of the vehicle; however, the second landed in the truck bed, igniting some parkas on the floor. The UCW team members jumped from the truck to escape the intense heat just as the pyrotechnics on board started to go off. The truck and almost \$8,000 worth of equipment went up in flames.

- A soldier was making homemade explosives in his room. He was closing one end of a container with a hammer when the explosives went off. The blast amputated the end of his thumb and forefinger and damaged the tendons of his middle finger. The injuries this soldier caused himself totaled \$43,000.

Whether because of improper training, unsafe practices, or Murphy's Law, all of these accidents can be traced back to improper use of explosives materials. Commanders will have to be ever more vigilant in their efforts to track down these practices and wipe them out.

Five tactics have been proven to be the best tools at the commander's disposal:

- Commanders must establish safe performance criteria.
 - Positive support for safety must come from higher headquarters.
 - Operations have to be conducted by the book.
 - Immediate enforcement action must be taken against violators of safe procedures.
 - Strong command emphasis must be placed on training.
- Forces need not only to be ready; they must be safe and ready.

Recommended Manuals for Explosives and Demolitions

FM5-25, Explosives and Demolitions, 10 Mar 86

FM5-34, Engineer Field Data, 24 Sep 76

FM9-16, Explosive Ordnance Reconnaissance, July 81

FM23-30, Grenades and Pyrotechnic Signals, 16 Dec 69 (Draft Form 19 Nov 87)

AR75-1, Malfunctions Involving Ammunition and Explosives, Jun 85

AR75-15, Responsibilities for Explosive Ordnance Disposal, 1 Nov 78

AR385-63, Policies and Procedures for Firing Ammunition for Training, Target Practice, and Combat, Oct 83

AR385-64, Ammunition and Explosives Safety Standards, 15 Apr 83

TM9-1300-200, Ammunition, General, Oct 69

TM9-1300-206, Ammunition and Explosives, Standards, Aug 73

TM9-1300-214, Military Explosives, 20 Sep 84

TM9-1300-250, Ammunition Maintenance, 25 Sep 69

TM9-1370-206-10, Pyrotechnic Signals, July 78

TM9-1370-207-10, Pyrotechnic Simulators, Operators Manual, 30 Dec 83

TM9-1370-208-10, Photoflash Cartridges, Surface Flares, and Miscellaneous Pyrotechnic Items, Nov 81

TM9-1375-200/2, Use of Mine, Antitank, 14 Jun 71

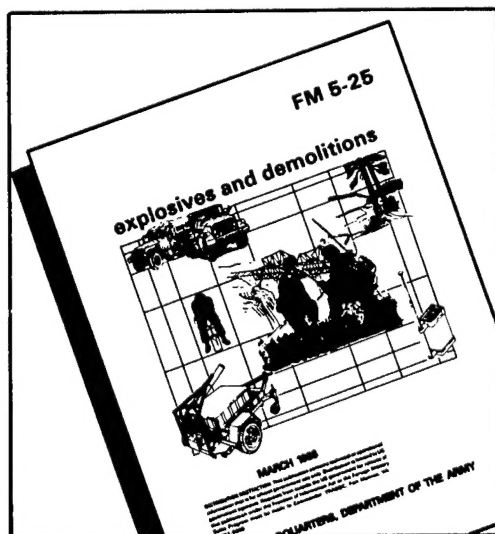
TM9-1375-213-12, Demolition Materials, Mar 73

TM43-0001-37, Army Ammunition Data Sheets for Military Pyrotechnics, Feb 77

TM43-0001-38, Army Ammunition Data Sheets for Demolition Materials, Jun 81

GTA5-10-28, Demolition Card, Jul 86

Do's and Don'ts



Following is a list of Demolitions Do's and Don'ts that was prepared by the Demolitions Committee of the Engineer Center Fort Belvoir, Virginia.

The list is not intended to be all inclusive. Its purpose is to assist supervisors at all levels in their planning and execution of demolitions training. The list also serves as a ready reference for leaders who are checking demolition training plans and exercises. This list in no way substitutes for the requirement to reference the appropriate technical or field manual. Use of this list should always be in conjunction with FM5-25.

The conduct of live demolitions missions should only be attempted as a result of a thorough training program. Live demolitions must be executed by personnel with a sound knowledge and hands-on experience in demolition techniques and procedures.

Detailed technical inquiries regarding this list should be directed to U.S. Army Engineer Center, ATTN: ATZA-TE-FE, Fort Belvoir, VA 22060-5291, Autovon 354-6901.

Demolition Do's

1. Always post guards to prevent access inside the danger radius.
2. Always use the minimum amount of explosives necessary to accomplish the mission.
3. Always use the minimum number of personnel necessary to accomplish the mission.
4. Supervisors must maintain control of the blasting machine.
5. The firing point end of firing wire must be guarded and kept disconnected and shunted until ready to fire.
6. Misfires should be checked by the OIC or RSO. If for some reason, they are unfamiliar with the setup of the demolition, the soldier who set the charge will accompany them, returning to the safe point when no longer required.
7. Keep flame producing devices at least 50 feet from vehicles carrying explosives.
8. Keep explosive materials away from food and eyes. Wash hands after handling.
9. Clear the immediate area of vehicles, equipment and extra explosive materials.
10. Ensure there are no foreign objects or moisture in a fuse lighter or blasting caps prior to inserting the time fuse.
11. Always conduct a test burn of at least three feet of time fuse to determine its burn rate.
12. Determine the length of time fuse required by walking the route to your safe point.
13. Use only M2 crimpers when cutting time fuse/det cord or when crimping.
14. Crimp blasting caps prior to placing in explosives.
15. Always sound adequate warning (non-wartime environment) prior to blast.
16. Always use nonsparking tools.
17. Always observe the minimum safe distances.
18. Remain in a safe area until the post blast fumes, dust and mists have subsided.
19. Always observe the minimum waiting time prior to investigating a misfire.
20. When taping a blasting cap to det cord, ensure $\frac{1}{8}$ inch of the cap is clearly visible at both ends.
21. Remain in a safe area until the time has expired on all nonelectric systems and/or all firing wires have been connected to the blasting machine and fired (even if detonation has already occurred).
22. Always check firing wire for breaks and for continuity.
23. Firing wire should, whenever possible, be laid flat on the ground or buried.
24. Demolition circuits should, where possible, use blasting caps only to detonate det cord ring/line mains or branch lines if single charges.
25. All demolitions, dual or single primed, should be dual fired.
26. Connections between blasting cap leads and firing wire must be secured with insulating tape, not the cardboard spool.
27. When two nonelectric blasting caps are used to dual fire a demolition or to fire two separate charges, the time fuse will be cut to allow an interval of not less than 10 seconds between firings.
29. Do ask for assistance if you are unsure of what you are doing.

Demolition Don'ts

1. Don't connect blasting caps to det cord leads from the charge until all nonessential personnel have moved to a safe area. Only the person detailed to connect and fire the demolition, the instructor, and the RSO should remain behind.
2. Don't leave blasting caps unattended before or after attachment to the charge or firing wire.
3. Don't carry blasting caps or explosives in pockets.
4. Don't mix explosives and blasting caps of different manufacture.
5. Don't divide responsibility for demolition operations.
6. Don't conduct live demolition training or exercises during the approach or progress of an electrical storm.
7. Don't transport or store blasting caps with explosives.
8. Don't mix live explosives with inert or dummy material.
9. Don't bury time fuse or blasting caps or use in boreholes.
10. Don't let inexperienced personnel handle explosives.
11. Don't insert anything but time fuse or det cord into a nonelectric blasting cap.
12. Don't use old, deteriorated or damaged explosives.
13. Don't rush when working with explosives.
14. Don't place explosives where they will be exposed to flame, excessive heat, sparks or impact.
15. Don't attempt to fire electric blasting caps with less than the minimum current required.
16. Don't leave a vehicle containing explosive material unattended.
17. Don't take apart or alter the contents of any explosive materials.
18. Don't use aluminum wire in an electrical system.
19. Don't use electric blasting caps within 155 meters of an energized power line.
20. Don't twist time fuse inside the blasting cap.
21. Don't cut time fuse until you are ready to insert into the igniter and blasting cap.
22. Don't use the first and last 6 inches of any new or partially used roll of time fuse.
23. Don't violate the required safety distance rules.
24. Don't walk on det cord or firing wire.
25. Don't connect a blasting machine to firing wire through the unused portion of the drum. It must be kept as short as possible and cut to length.
26. Don't allow firing wire to form loops when laid on the ground.
27. Don't allow det cord to make any sharp bends or loops.
28. Don't attempt to carry out a mission or any aspect of a mission if you are unsure of what you are doing. Stop and obtain assistance.

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